

# **Slipped Capital Femoral Epiphysis in Southern Sweden - Long-term Results After Nailing/Pinning**

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## ABSTRACT

172 patients with 204 slipped capital femoral epiphyses treated with nailing or pinning were evaluated on average 28 years after surgery by questionnaire in 153 cases (181 hips) and by clinical and radiographical re-examination in 132 cases (157 hips). Segmental collapse was seen in 4 of 179 hips nailed/pinned in situ and in 4 of 25 hips operated after reduction. This was the only early complication associated with problems at re-examination. Arthrosis was twice as frequent after reduction (53 %) than after fixation in situ (24 %). The clinical and radiographical results were better than those from the same region after other methods of treatment. Nailing or pinning in situ is the method of choice when possible regardless of degree of slipping. Bilateral slipping was found in 67 % at follow-up, indicating prophylactic pinning of the contralateral hip in cases with unilateral slipping.

## INTRODUCTION

The treatment of slipped capital femoral epiphysis (physiolysis colli femoris - PCF) varies in most reports with the degree of slipping.

Pinning in situ<sup>3,16,21,24,29,31</sup> or bone pegging physiodesis<sup>10,18</sup> is most widely used in mild PCF.

In moderate PCF several authors advocate realignment procedures; osteotomy through the physis or mid-neck region<sup>12,20</sup>, at the base of the femoral neck<sup>13,21</sup>, or in the trochanteric-subtrochanteric region<sup>10,27</sup>. Some authors<sup>6,8,29,32</sup> reported good results after nailing or physiodesis in situ even in moderate PCF.

In severe PCF many authors<sup>10,11,12,13,20,21,27,30</sup> recommend a realignment osteotomy. However, Herndon et al<sup>17</sup> reported excellent or good results in 25 of 32 hips five years after physiodesis and removal of the bone prominence of the femoral neck. Boyer et al<sup>6</sup> found good results in 6 of 7 severe slips treated without realignment on average 31 years before examination.

The most important early problems, segmental collapse and chondrolysis, have been analyzed in many studies. The major late problem, arthrosis, is often not seen until middle-life<sup>19</sup>. Thus, comparison between methods of treatment must be based on both short-term and long-term follow-up investigations.

We investigated 153 patients (181 hips) 20 - 42 years after nailing or pinning. The results are compared with previously reported long-term results from Southern Sweden<sup>15,25,26</sup> with other methods of treatment.

## MATERIAL AND METHODS

Between 1940 and 1964, 204 hips with slipped capital femoral epiphyses in 172 patients were treated by nail or pin fixation at three orthopaedic departments in Southern Sweden. 111 (65%) of these patients were males, with an average age at surgery of 14.4 years (range, 5.5 - 23), and 61 (35%) were females with an average age of 12.5 years (range 8.5 - 16). 88 cases (51%) were nailed/pinned on the left side, 52 (30%) on the right, and 32 (19%) bilaterally. A further 10 cases with unilateral nailing/pinning had slipping in their second hip treated by closed reduction and hip spica (two cases), femoral neck osteotomy (two cases), screw fixation (two cases) and in one case an unknown type of nail or screw was used. The slip was in three cases left without treatment. In total 42 cases (24%) demonstrated signs of bilateral slipping. Twenty of these had bilateral slipping at admission, the remaining were diagnosed later during adolescence.

The three-flanged Sven Johansson nail of stainless steel, or a vitallium<sup>R</sup> nail of essentially the same type (Figure 1) was used in 116 hips (57%). The Nyström pin of stainless steel or vitallium<sup>R</sup> (Figure 1) was used in 88 hips (43%). In one hip three pins were used, in four hips two pins were used and in the remaining one pin. The Johansson nail was mainly used up to the middle of the fifties; the Nyström pin during the fifties and sixties.

There was no registered attempt to reduce the displacement before fixation in 179 hips (88%). In 6 hips preoperative pin traction was used with improved position. Closed reduction in anesthesia was performed in another 17 hips. In 16 hips there was an improved position of the epiphysis; in one hip no change was seen. Open reduction was performed in 2 hips.

Complications were in all 204 hips searched for in clinical and radiographical reports.

At follow up 5 males and 2 females (8 nailed/pinned hips) had died for reasons unrelated to their PCF. One male treated by femoral neck osteotomy because of further slipping 3 years after nail extraction was excluded. Eight males and 3



females (14 operated hips) could not be identified and contacted and therefore excluded.

The remaining 153 patients -89%- (97 males, 56 females - 181 hips) were identified and answered a questionnaire on medical and social problems related to their hips. Out of these, 129 patients -75% of total, 84% of identified- (84 males, 45 females - 154 hips) were available for clinical and radiographical re-examination. In another three males, operated on with THR, arthrodesis and Mc Murray osteotomy, respectively, preoperative data were used. The follow-up was carried out on average 28 years (range 20 - 42) after nailing/pinning, so the ages of the patients varied between 31 and 63 years at follow-up.

The clinical state at follow up was classified according to Charnley<sup>9</sup>, based on the system of d'Aubigne' and Postel<sup>23</sup>.

At radiographic examination, both hips were evaluated, and the degree of slipping were classified<sup>4</sup> (Table 1). AP and Lauenstein projections were used. The calcar femorale was visualized in fluoroscopy and the position of this structure was related to the femoral head to evaluate the degree of slipping<sup>25</sup>. As preoperative radiographs were missing in general, the initial degree of slipping was unknown in those treated with reduction. The presence of arthrosis was classified<sup>1</sup> (Table 1).

## RESULTS

### Peroperative problems (Table 2)

Physeal separation and displacement of the femoral head up to 10 mm was registered in 11 nailed and 2 pinned hips. The nail/pin was withdrawn about 5-10 mm in 5 hips. In two hips the nail was extracted and replaced by a Nyström pin. The separation was eliminated by hammering on the trochanteric area in 3 hips. In the remaining 3 hips the separation was left, but disappeared soon after surgery.

Perforation of the subchondral bone of the femoral head was registered in 4 nailed and 3 pinned hips. In all cases the nail/pin was withdrawn 5-10 mm. In one male, the guide wire broke when driving in the nail. The proximal part, not penetrating the subchondral bone, was left in the bony epiphysis.

### Postoperative problems during the adolescent period (Table 2)

Deep infection was noted in two patients. Both healed without sequelae after operative drainage and nail extraction. The femur fractured at the level of the base of the nail in four hips after Johansson nailing 3, 12, 12 and 13 months, respectively, after operation. In all cases the fracture was due to a trauma. Segmental collapse was registered in 8 hips. Closed reduction was performed in 4 of these cases. There was no registered case with chondrolysis in the material.

Lost epiphyseal grip due to sliding of the nail/pin before growth plate closure was registered in 13 hips. Renailing/pinning was performed in 11 cases. In three hips the reinserted nail/pin had also slid and a third operation with nailing/pinning was performed. In two cases the nail was extracted. One of these patients sustained a maximal slipping, and was reoperated with femoral neck osteotomy 3 years after the primary operation (see above).

Lost epiphyseal grip due to the growth in length of the femoral neck was seen in one nailed and 13 pinned hips. All were reoperated by fixation with a longer nail

or pin. Three pinned hips required another reoperation and a longer pin.

### Social consequences

All patients completed primary school; 147 in the normal time period, 6 with a delay of one year. Twenty-two males were exempted from military service because of the operated hip, 29 had done full and 46 reduced military service.

32 males and 15 females considered that their PCF had influenced their choice of profession. On the other hand, 32 males and 16 females were working in occupations which they characterized as physically heavy. 64 males and 38 females characterized their work as physically light. One male was retired because of arthrosis in the nailed hip, two females were retired because of poliomyelitis and epilepsy, respectively.

### Secondary operations in the adult period

The nail/pin was extracted after physeal closure in 74 hips (36 nails, 38 pins). 24 patients (10 nails, 14 pins) had lateral complaints from the hip resulting in extraction.

Three males were operated on because of grade 3 arthrosis. Intertrochanteric osteotomy was performed in one 17 years after pinning in situ, hip fusion in one 22 years after closed reduction and nailing and THR in one 34 years after nailing in situ. Yet another male and female with grade 3 arthrosis were planned for THR at follow-up.

### Other medical problems

One male had hypothyroidism diagnosed several years before his PCF. At slipping, at the age of 23 years in 1943, he was given treatment with thyroid hormones. Another male with severe bilateral slipping had Downs syndrome. Sequelae after poliomyelitis, antiepileptic medication and rheumatoid arthritis, respectively, impaired the hip function in three females. Six males and one female reported low back pain with a minor effect on walking capacity. One male and

three females had knee pain, which also slightly affected their walking capacity.

### Function (Table 3)

At follow up 123 nailed/pinned hips (68%) were pain-free and 58 hips had various degrees of pain. The 4 hips with pain at rest all had grade 3 arthrosis. Thirty-nine cases complained of stiffness in the operated hip. There was reduced internal rotation ( $p < .001$ ) and abduction ( $p < .01$ ) after operation in situ as well as after operation with reduction, compared with the unslipped hips. Those operated with reduction also had reduced flexion and external rotation, compared with unslipped hips and compared with hips operated on in situ ( $p < .001$  in all comparisons). The 7 hips with a total motion below  $100^\circ$  all had grade 3 arthrosis. Seventy one males -73%- (90 hips) and 44 females -79%- (50 hips) walked unlimited distances without limping or using walking aids. An additional 18 males (18 hips) and 7 females (8 hips) walked without aids, but with a limp.

The leg length discrepancy was analysed in all the 44 cases with unilateral slipping at follow-up radiography. The operated leg was shortest in all but two cases. The mean difference, measured between the superior anterior iliac spine and the medial malleolus, was 0.8 cm (range,  $-2/+1$ ), and measured between the umbilicus and the medial malleolus 0.5 cm (range,  $-2/+1$ ). There was no difference in leg length discrepancy with nailing compared with pinning, or in patients treated with reduction compared with those nailed/pinned in situ.

### Radiography

Among the 132 patients radiographically examined, 220 hips showed slipping (Table 4). Eighty-eight patients (67%) had bilateral slipping, and out of these 55 were not diagnosed during adolescence (Table 4). Arthrosis was seen in 16 of these undiagnosed slippings.

Of the 157 nailed or pinned hips, 15 showed mild slipping, 55 moderate slipping and 83 severe slipping (Table 4). In four hips classification of slipping was not possible. There were more nailed than pinned hips with severe slipping (Figure



2), and more hips with severe slipping during the earlier years of the investigation (Figure 3). Arthrosis was seen in 43 out of the 157 nailed/pinned hips at follow up (Table 4). 30 hips showed grade 1 arthrosis and 13 grade 3 arthrosis. No grade 2 or 3 arthrosis was seen in hips with mild or moderate slipping.

Of the 17 hips treated with reduction grade 1 arthrosis was seen in one hip with severe slipping. Grade 3 arthrosis was seen in seven hips with severe slipping and in the hip with an uncertain degree of slipping (Figure 2). Seven of the eight males with more than 35 years follow-up showed arthrosis (Figure 4). The eight cases with grade 3 arthrosis were treated by closed reduction (6 cases), open reduction (1 case) and preoperative pin traction (1 case). Johansson nailing was used in all 8 cases.

Among the 140 hips operated on with nailing/pinning in situ, grade 1 arthrosis was seen in one hip with mild slipping, five hips with moderate and in 23 hips with severe slipping (Figure 2). Five hips (males) with severe slipping showed grade 3 arthrosis; Johansson nailing was used in 3 hips and Nyström pinning in 2. In these unreduced cases, there was no obvious increase of arthrosis during the period 20 - 40 years after surgery (Figure 4).

The radiographic findings in the cases with various early complications (Tables 2 and 5), showed that only segmental collapse was correlated to arthrosis.

The position of the nail or pin in relation to the anticipated position of the growth plate was analysed in the 74 hips with nail/pin left at follow up. In 16 of 43 nailed hips and in 12 of 25 pinned hips, the growth plate was proximal to the top of the nail/pin indicating failure at surgery or lost epiphyseal grip, due to sliding of nail/pin or growth in length of the femoral neck. In another 6 hips the relation was doubtful. However, no difference was seen, regarding slipping or arthrosis in relation to nail/pin position (Table 5).

Other methods of treatment were used in 8 examined hips with severe slipping. Two hips treated with reduction and screw fixation and two hips left without treatment had no arthrosis. Two hips treated with closed reduction and hip

plaster spica and two hips treated with femoral neck osteotomy had grade 3 arthrosis. One hip treated with fixation using an unknown type of nail or screw also had grade 3 arthrosis.

21 patients (10 males, 11 females - 24 hips) answered the questionnaire, but were unable to come for re-examination. From the questionnaire the long-term results in these patients seemed to correspond to those re-examined: All 21 patients walked unlimited distances. 14 patients were pain-free, 4 had pain only after some activity and 3 only initially when starting to walk. None had been operated on for arthrosis.

## DISCUSSION

Wiberg<sup>29</sup> reviewed 185 hips with PCF operated on with nailing or pinning, about two years after surgery. 184 hips had mild or moderate slipping. Segmental collapse was seen in two cases and chondrolysis in another two. He concluded that nailing or pinning is a satisfactory method for the treatment of mild and moderate slipping. Wilson<sup>31</sup> re-examined 187 hips pinned in situ and 76 hips treated with reduction and fixation. The follow-up averaged 12 - 13 years. The radiographic rating was in those operated in situ: 163 good, 19 fair, 5 poor and in those operated with reduction: 42 good, 20 fair, 14 poor. He also concluded that pinning in situ was the method of choice in mild and most moderate slipping. Boyer et al<sup>6</sup> evaluated 121 cases (149 hips) with various methods of treatment on average 31 years after primary treatment. They found excellent results in most mild and moderate slippings treated with pinning in situ. Six of seven severe slipped hips treated without realignment had good results.

In this investigation the long term results in 153 patients with 181 slipped hips treated with nailing or pinning (out of 172 patients/204 hips = 89 % included) are presented with a follow-up ranging between 20 and 42 years. The results have been compared with those from other types of treatment regarding early as well as late problems.

Physeal separation was more frequent after osteosynthesis with the blunt Johansson nail than after the pointed Nyström pin. However, this complication was not associated with segmental collapse or arthrosis, as described by Wilson et al<sup>31</sup>. Perforation of the subchondral bone is probably more frequent than registered when using AP and Lauenstein projections<sup>2,22,28</sup>. This perforation has been associated with chondrolysis<sup>28</sup>. In this investigation there was no registered case with chondrolysis. At follow-up examination, however 2 cases out of 5 with previous perforation had grade 1 arthrosis. As the primary radiographs in most cases were missing, there may have been some hips with chondrolysis not mentioned in the clinical or radiographical reports.

Lost epiphyseal grip due to the growth in length of the femoral neck was more frequent after pinning (Table 2). Probably greater damage is done to the physis when driving in the blunt nail, and there is an increased risk of growth retardation and premature growth plate closure. After lost epiphyseal grip, due to sliding or growth in length, there is a risk for reslipping. Adding those reoperated because of lost grip to those with the physeal scar proximal to the top of the nail/pin at reexamination, it appears that if diagnosed before physeal closure about 45 % of nailed and 70 % of pinned hips require renailing/pinning to prevent reslipping. Using nails or pins without satisfactory anchorage in the bony epiphysis, the patient must be followed radiographically up to growth plate closure to avoid this complication<sup>16</sup>. Correspondingly, the nail/pin must not be removed before growth plate closure. In fact, the case excluded from follow-up because of secondary operation with femoral neck osteotomy as a result of further slipping after nail extraction, should be regarded as failure for this reason. The high risk for lost epiphyseal grip has during the last decade changed our policy in favour of the hook-pin<sup>16</sup>.

Segmental collapse was seen in four hips out of the 25 treated with reduction before nailing/pinning. The high risk is in accordance with the results after closed reduction and hip spica<sup>26</sup>. Segmental collapse predisposes to arthrosis at an early age as seen in 3 out of 5 cases (Table 5).

The PCF did not affect school attendance in general. Although two thirds of the patients chose occupations without considering their PCF, only one male was retired at re-examination because of his operated hip.

Long term follow-up results in Southern Sweden, using the same classifications as in this investigation, have been presented after no primary treatment<sup>25</sup>, closed reduction and hip spica<sup>26</sup>, and femoral neck osteotomy<sup>15</sup>. The results regarding pain, walking and motion (Table 3) were in this investigation better than the earlier presented methods of treatment, even when compensating for degree of slipping. However, the mean follow-up time was somewhat longer in those left without primary treatment (37 years, range 20 - 60) and in those treated with closed reduction and hip spica (46 years, range 25 - 66). The follow-up time in those treated with femoral neck osteotomy was 28 years (range 16 - 32). The



difference was most pronounced regarding motion and walking. Some patients in this investigation had pain owing to pin protrusion or inflammatory reaction due to metallic corrosion, and this disappeared after nail/pin extraction.

There were more hips with severe slipping during the earlier years (Figure 3), and more nailed than pinned hips with severe slipping (Figure 2). This could be explained by a longer delay between onset of slipping and diagnosis during the earlier years<sup>14</sup>, and a corresponding higher percentage of severe slipping. However, during the fifties and early sixties, when pinning was mostly used, some hips with severe slipping were treated by femoral neck osteotomy<sup>15</sup>.

No grade 3 arthrosis was seen among those with mild or moderate slipping, while among 83 cases with severe slipping there were 13 with grade 3 arthrosis (Figure 2). The frequency of arthrosis did not increase during the period 20 - 40 years after primary surgery in cases operated on without reduction (Figure 4), despite the greater degree of slipping in those operated on in the earlier years. However, in cases operated on with reduction the frequency increased with time after surgery. Arthrosis was about twice as frequent after reduction than after fixation in situ. Regarding grade 3 arthrosis only, the difference was 13:1. No treatment<sup>25</sup>, closed reduction and hip spica<sup>26</sup>, or femoral neck osteotomy<sup>15</sup> also resulted in a greater frequency and severity of arthrosis than nailing/pinning in situ.

Some authors<sup>10,18</sup> prefer bone-pegging through the growth plate of the femoral neck in mild and sometimes moderate slipping. This method has shown good short-term results, similar to nailing/pinning. However, the operative procedure is more complicated, and the patients are not allowed full weight-bearing postoperatively. The physiodesis may result in leg length discrepancy and limited range of abduction owing to continuous growth of the trochanter major<sup>18</sup>, which is important in cases with early and unilateral slipping. The use of screws<sup>7</sup> to achieve growth plate closure results in the same problems with leg length discrepancy and reduced abduction, besides the problems at insertion and extraction.

Bilateral PCF are diagnosed in 20 - 25 % during adolescence in most investigations<sup>14,31</sup>, as in this material (24 %). Using more careful radiographic analysis, Klein et al<sup>20</sup> reported 41 % bilateral slipping, Jerre<sup>19</sup> 42 %, and Billing and Severin<sup>5</sup> 80 % bilateral slipping. At radiographic follow-up bilateral slipping was seen in 88 patients (67 %) in this material. Arthrosis was seen in 16 hips with PCF not diagnosed during adolescence. The high frequency of bilateral slipping, and the corresponding increased risk for arthrosis have changed our policy. All cases with PCF are nowadays treated by prophylactic pinning of the contralateral hip, using the hook-pin which has been shown to prevent slipping without complications in the unslipped hips<sup>16</sup>.

In conclusion, the long-term results after PCF mainly depend on the severity of slipping at diagnosis and the method of treatment. If technically possible, pinning in situ seems to be the method of choice, regardless of the degree of slipping. Preoperative pin traction with internal rotation and abduction in combination with gentle peroperative reduction, if indicated, should only be tried for acute severe slipping. Many early complications are prevented by using pins with satisfactory anchorage in the epiphysis permitting undisturbed growth in length of the femoral neck. The risk of fracture and physeal separation is avoided by using a thin pin placed in a predrilled hole<sup>16</sup>. Prophylactic pinning of the contralateral hip is recommended.

## FIGURE LEGENDS

Figure 1. Johansson nail (left) and Nyström pin (right).

Figure 2. Arthrosis in relation to nailing/pinning and degree of slipping in 157 nailed/pinned hips. In reduced hips degree of slipping at follow-up.

\* = slipping, classification not possible.



= No arthrosis



= Grade 1 arthrosis



= Grade 3 arthrosis

(No hip with grade 2 arthrosis at follow-up)

Figure 3. Slipping in relation to follow-up time in 157 nailed/pinned hips. In reduced hips degree of slipping at follow-up.



= Mild slipping



= Moderate slipping



= Severe slipping



= Slipping, classification not possible

Figure 4. Arthrosis in relation to follow-up time in 157 nailed/pinned hips. Same symbols as in Figure 2.

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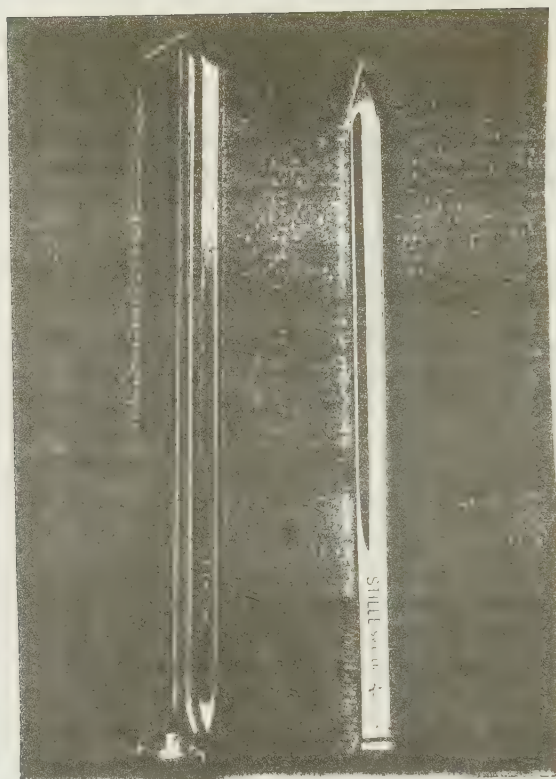


FIG 1

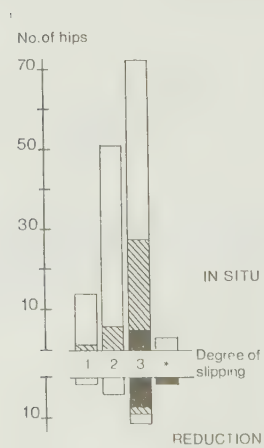


FIG 2

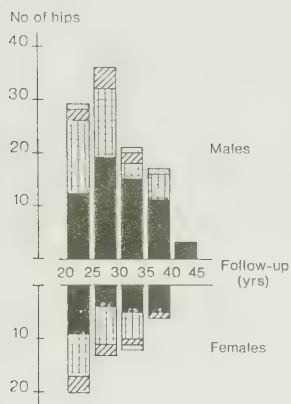


FIG 3

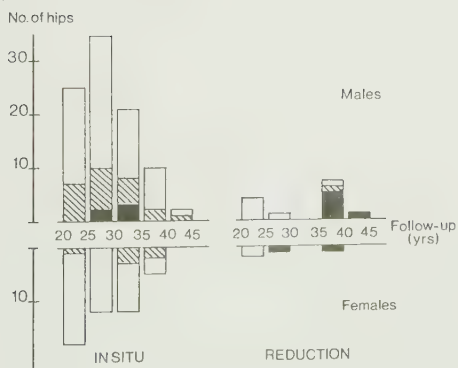


FIG 4



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Table 1. Classification of Slipping and Arthrosis

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Slipping

0 = No slipping

1 = Mild slipping - (displacement  $< 1/3$  of diameter of bony epiphysis)

2 = Moderate slipping - (displacement  $1/3$ - $2/3$  of diameter of bony epiphysis)

3 = Severe slipping - (displacement  $> 2/3$  of diameter of bony epiphysis)

Arthrosis

0 = No arthrosis

1 = Reduction of articular space

2 = Obliteration of articular space

3 = Bone attrition

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Table 2. Early complications in 204 nailed/pinned hips

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|                                        | <u>Nailing (116 hips)</u> | <u>Pinning (88 hips)</u> | <u>Total</u> |
|----------------------------------------|---------------------------|--------------------------|--------------|
| Physeal separation                     | 11                        | 2                        | 13           |
| Perforation of sub-<br>chondral bone   | 4                         | 3                        | 7            |
| Fracture                               | 4                         | 0                        | 4            |
| Segmental collapse                     | 5                         | 3                        | 8            |
| Chondrolysis                           | 0                         | 0                        | 0            |
| Lost epiphyseal grip<br>due to sliding | 8                         | 5                        | 13           |
| Lost epiphyseal grip<br>due to growth  | 1                         | 13                       | 14           |

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The complications listed above occurred in 29 nailed and 24 pinned hips.

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Table 3. Clinical Follow-up According to d'Aubigné and Postel, and Charnley

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|                                               | Nailed/pinned<br>in situ |         | Nailed/pinned<br>after reduction |         |
|-----------------------------------------------|--------------------------|---------|----------------------------------|---------|
|                                               | Males                    | Females | Males                            | Females |
| <hr/>                                         |                          |         |                                  |         |
| <u>Pain</u> (Questionnaire - 181 hips)        |                          |         |                                  |         |
| 1                                             | 3                        |         | 1                                |         |
| 2                                             | 4                        | 7       | 4                                | 2       |
| 3                                             | 9                        | 6       | 3                                | 1       |
| 4                                             | 6                        | 7       | 1                                |         |
| 5                                             | 2                        | 1       |                                  | 1       |
| 6                                             | 78                       | 38      | 6                                | 1       |
| <br><u>Motion</u> (Reexamination - 157 hips)  |                          |         |                                  |         |
| 1                                             | 1                        |         | 1                                | 1       |
| 2                                             | 2                        |         | 1                                | 1       |
| 3                                             | 2                        |         | 1                                |         |
| 4                                             | 14                       | 5       | 3                                |         |
| 5                                             | 50                       | 16      | 7                                | 1       |
| 6                                             | 24                       | 26      |                                  | 1       |
| <br><u>Walking</u> (Questionnaire - 181 hips) |                          |         |                                  |         |
| 1                                             |                          |         |                                  |         |
| 2                                             |                          |         | 1                                |         |
| 3                                             | 1                        |         | 1                                |         |
| 4                                             | 4                        | 4       | 2                                | 2       |
| 5                                             | 17                       | 7       | 1                                | 1       |
| 6                                             | 80                       | 48      | 10                               | 2       |

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Table 4. Slipping and arthrosis at follow-up in 256 hips

|                                         |         | Total<br>number<br>of hips | Slipping |    |    |    |   | Arthrosis |    |   |    |
|-----------------------------------------|---------|----------------------------|----------|----|----|----|---|-----------|----|---|----|
|                                         |         |                            | 0        | 1  | 2  | 3  | * | 0         | 1  | 2 | 3  |
| Nailing/pinning<br>in situ              | Males   | 93                         |          | 8  | 31 | 52 | 2 | 65        | 23 |   | 5  |
|                                         | Females | 47                         |          | 6  | 20 | 20 | 1 | 41        | 6  |   |    |
| Nailing/pinning<br>with reduction       | Males   | 13                         |          |    | 4  | 8  | 1 | 6         | 1  |   | 6  |
|                                         | Females | 4                          |          | 1  |    | 3  |   | 2         |    |   | 2  |
| Slipping diag-<br>nosed at<br>follow-up | Males   | 38                         |          | 28 | 8  | 2  |   | 24        | 13 |   | 1  |
|                                         | Females | 17                         |          | 11 | 6  |    |   | 15        | 2  |   |    |
| No slipping<br>at follow-up             | Males   | 25                         | 25       |    |    |    |   | 23        | 2  |   |    |
|                                         | Females | 19                         | 19       |    |    |    |   | 19        |    |   |    |
| Total                                   |         | 256                        | 44       | 54 | 69 | 85 | 4 | 195       | 47 |   | 14 |

\* Slipping, classification not possible.

8 hips with other methods of treatment in the contralateral hip excluded.

Table 5. Slipping and arthrosis at follow-up in relation  
to early complications in 157 nailed/pinned hips

|                                        | Slipping |   |   |   | Arthrosis |   |   |   | Total |
|----------------------------------------|----------|---|---|---|-----------|---|---|---|-------|
|                                        | 1        | 2 | 3 | * | 0         | 1 | 2 | 3 |       |
| Physeal separation                     | 3        | 6 | 1 |   | 9         | 1 |   |   | 10    |
| Perforation of sub-<br>chondral bone   | 1        |   | 4 |   | 3         | 2 |   |   | 5     |
| Fracture                               |          | 1 | 2 |   | 1         | 2 |   |   | 3     |
| Segmental collapse                     | 1        | 1 | 2 | 1 | 2         |   |   | 3 | 5     |
| Lost epiphyseal grip<br>due to sliding | 2        | 5 | 4 |   | 9         | 2 |   |   | 11    |
| Lost epiphyseal grip<br>due to growth  | 2        | 8 | 3 | 1 | 13        | 1 |   |   | 14    |

\* Slipping, classification not possible.

The complications listed above occurred in 42 hips.





